The Fox Project: Advanced Development of Systems Software

R&D Status Report
October 1 to December 31, 1999

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The long-term objectives of the Carnegie Mellon Fox Project are to improve the design and construction of systems software and to further the development of advanced programming language technology. We use principles and techniques from the mathematical foundations of programming languages, including semantics, type theory, and logic, to design and implement systems software, including operating systems, network protocols, and distributed systems. Much of the implementation work is conducted in the Standard ML (SML) language, a modern functional programming language that provides polymorphism, first-class functions, exception handling, garbage collection, a parameterized module system, static typing, and a formal semantics. This Project involves several faculty members and spans a wide range of research areas, from (1) advanced compiler development to (2) language design to (3) software system safety infrastructure.

1   Research Progress

We report on the research accomplishments during the fourth calendar quarter of 1999, and the research objectives for the first quarter of 2000.

Accomplishments (October-December):

- Completed implementations of several parallel variations of standard garbage collectors.

- Continued maintenance of the SML/TILT system.

- The TILT compiler for Standard ML was released to other researchers at Carnegie Mellon. This is the first release of TILT to other developers.

- Proved the correctness of an algorithm for eliminating type definitions in Standard ML, with applications to certified compilation of ML programs.

- Presented a thesis proposal on November 19th entitled A Security-Property Language for Self-Certified Code.

Objectives (January-March):

- Complete the first public release of TILT compiler.

- Publish a technical report based on revision of material from thesis proposal, A Security Property-Language for Self-Certified Code.

- Obtain parallel benchmarks for analyzing the performance characteristics of various scalable parallel garbage collectors.

- Release a new version of the Twelf logical framework.

- Develop technology (logical relations proof techniques) for proving the correctness of program transformations in the presence of recursive types.

2   Noteworthy Publications

- *Automated Techniques for Provably Safe Mobile Code.* Karl Crary, Robert Harper, Peter Lee and Frank Pfenning. DARPA Information Survivability Conference and Exposition (DISCEX 2000), vol. 1, pp. 406-419, Hilton Head Island, South Carolina, January 2000.

- *A Judgmental Reconstruction of Modal Logic.* Frank Pfenning and Rowan Davies. Submitted. This is the paper for an invited talk at the Workshop on Intuitionistic Modal Logics and Applications, Trento, Italy, July 1999.

- *The Relative Complement Problem for Higher-Order Patterns.* Alberto Momigliano and Frank Pfenning. International Conference on Logic Programming (ICLP'99), pp. 380-394, Las Cruces, New Mexico, November 1999.

- *Type-Safe Dynamic Linking of Native Code.* Karl Crary, Stephanie Weirich and Michael Hicks.

3   Capital Equipment Purchases

- None.

4   Key Personnel Changes

- None.

5 Noteworthy Meetings

- International Conference on Functional Programming (Paris, France, September 25-October 2, 1999).

6 Administrative Data

Base Funding (excludes options): 5,630,798

Funded Options:
UNFunded Options: 648,704

Total Funding Provided to Date (both base and options): 4,175,957
Total Funding Expended to Date (both base and options): 4,008,418
Total Funding UNExpended: 167,541

Date Current Funding will be Expended: 28 FEB 2000

Funding Expended in Most Recent Quarter: 190,466

Incremental Funding required for FY 2000: 850,000

Date of Financial Data: 31 DEC 1999